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Ultrasound evaluation of uterine and ovarian size from birth to puberty

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Abstract. Sonographic measurement of uterine and ovarian volume was performed in 178 healthy girls ranging in age from newborn to 14 years. High values were measured during the neonatal age and puberty, in contrast to those in subjects between 1 month and 7 years of age. We conclude that age and pubertal stage are important parameters in correctly interpreting the size of the uterus and ovaries in childhood.

Ultrasound imaging is a convenient, noninvasive diagnostic tool for investigating disorders in sexual development, i.e. precocious puberty, premature thelarche, or premature pubarche [1]. Although there have been several studies on the size of the uterus and ovaries during childhood [2–4] there is little information covering the entire span of child development. The development of high-resolution sonographic equipment now makes such examinations possible even in newborns. In this paper we present reference values for uterine and ovarian size in girls ranging between 1 day and 14 years of age.

Patients and methods

We studied 178 normal girls between the ages of 1 day and $14\frac{11}{12}$ years who were examined in our department on the grounds of minor, non-endocrinological acute pathology. Height, weight and pubertal development were within the normal range for age according to the data of Tanner and Whitehouse [5].

For the ultrasound examination, patients lay in the supine position and the conventional, full-bladder technique with a 3.5 or 5 MHz real-time sector scanner (Acuson 128, Mountain View, Calif. USA) was used. Uterine and ovarian volume were calculated using the formula for a prolate ellipsoid: longitudinal diameter × anterioposterior diameter × transverse diameter × 0.5233 (Fig. 1). The ovarian volume of each girl was calculated as the mean value of the right and

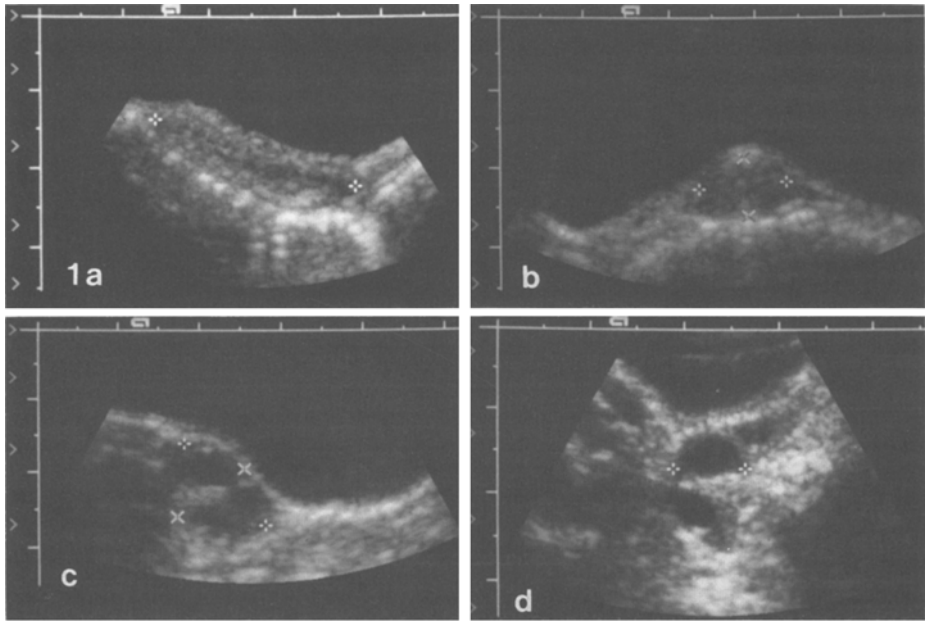

Fig. 1a–d. Ultrasound images (marked by *crosses*) of the uterus and ovary of a 3-year-old girl. Longitudinal (**a**) and transverse (**b**) sections through the uterus. The longitudinal (**c**) and transverse (**d**) sections through the ovary show several small cysts

Table 1. Uterine and ovarian volume in relation to age

Age	No.	Uterine volume	No.	Ovarian volume
0–1 month	15	3.4 (1.2)	6	0.5 (0.4)
3 months[a]	7	0.9 (0.2)	4	0.4 (0.1)
1 year	19	1.0 (0.2)	6	0.5 (0.2)
3 years	26	1.0 (0.3)	17	0.7 (0.4)
5 years	26	1.0 (0.3)	13	0.7 (0.5)
7 years	28	0.9 (0.3)	15	0.8 (0.6)
9 years	18	1.3 (0.4)	12	0.6 (0.4)
11 years	16	1.9 (0.9)	10	1.3 (1.0)
13 years	8	11.0 (10.5)	8	3.7 (2.1)
15 years	15	21.2 (13.5)	9	6.7 (4.8)

Values are the mean (SD) in milliliters
[a] This group comprises girls aged between 1.01 and 3 months. The remaining groups are analogous

Table 2. Uterine and ovarian volume[a] in relation to pubertal stage (breast)

Pubertal stage	No.	Uterine volume	No.	Ovarian volume
B 1	130	1.0 (0.3)	69	0.7 (0.4)
B 2	10	2.3 (0.6)	9	1.6 (0.9)
B 3	11	10.3 (6.1)	8	3.5 (1.8)
B 4–5	12	24.6 (14.4)	8	7.4 (4.8)

Values are the mean (SD) in milliliters
[a] In girls older than 1 month

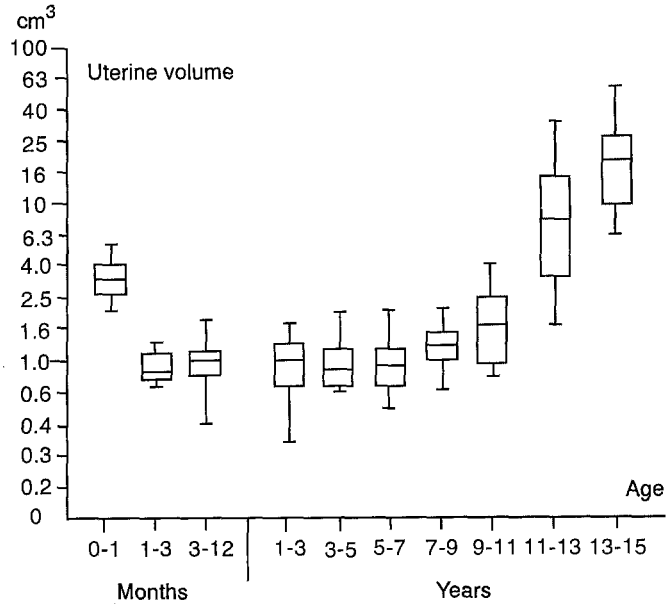

Fig. 2. Uterine volume after logarithmic transformation. Values are expressed as median *(horizontal line)*, 25th and 75th percentiles *(box)* and range *(vertical line)*

the left ovarian volumes excluding ovaries with macrocysts larger than 20 mm in diameter. All values are given as the mean ± SD unless otherwise stated. Student's *t*-test was used to analyse the data.

Results

The uterine volume was determined in all 178 girls, while a complete image of the ovaries was achieved in only 100 cases. Ovarian cysts were detected in 34% of our patients. Table 1 and Fig. 2 show uterine and ovarian volume in relation to age. The mean uterine volume was significantly higher ($p < 0.01$) in the 0 to 1-month group than in girls aged 1–3 months, while comparison of ovarian volume in these age groups revealed no difference. Uterine and ovarian volume remained static between the ages of 1 month and 7 years, the mean values being 1.0 ± 0.3 ml ($n = 106$) and 0.7 ± 0.5 ml ($n = 61$), respectively. We observed that this standstill was followed by a continuous increase in uterine volume with age. There was a statistically significant ($p < 0.05$) difference between the following age groups: 5–7, 7–9, 9–11, and 11–13 years. Ovarian volume starts to increase 2 years after the uterus gains in size, this being significant ($p < 0.05$) in the following groups: 7–9, 9–11, 11–13, and 13–15 years.

Uterine and ovarian volumes grouped according to pubertal stage (B) are listed in Table 2. Uterine volume was statistically significantly related ($p < 0.01$) to pubertal stage. Similar findings ($p < 0.05$) resulted from an analysis of ovarian volume, except for the pubertal stages B 3 and B 4–5, which were not significantly different from each other.

Discussion

In this study we present data on uterine and ovarian volume in healthy children from the neonatal age to puberty. In the first month of life, uterine volume declines and remains low until the child reaches about 7 years of age. This initial decline has been confirmed by the results of anatomical studies [6] and is a consequence of the withdrawal of maternal oestrogens after birth. A review of medical literature showed that very few ultrasound studies on neonates have been done [7, 8]. In the only study involving girls younger than 1 month of age, there was a gradual decrease in uterine volume from 3.6 ± 1.9 ml in girls aged 0–4 weeks to 1.7 ± 0.7 ml in girls aged 5 weeks to 1 year and 1.1 ± 0.3 ml in girls aged older than 1 year [8]. Although no statistical evaluation of these values was done, they indicate a gradual decline during the first year of life. In contrast, our data show a significant decline in uterine size during the first month of life, followed by a period of constant size from 2 months to 7 years. Evidence of such an early decrease in uterine volume is supported by data from anatomical studies by Krantz et al. [6], in which a postnatal regression of uterine size during the first month of life was described. Our data also indicate that a withdrawal of maternal oestrogens results in uterine regression, as an analysis of the serum concentration of free oestradiol showed a marked decrease within the first 6 weeks of life [9].

The only report on ovarian volume of girls younger than 2 years of age was by Stanhope et al. [7], who determined a mean value of 1 ml in eight girls. Our mean value of 0.5 ± 0.3 ml, which was calculated by grouping together all 26 girls younger than 2 years, compares reasonably well with this. Our data, moreover, indicate that ovarian volume remains unchanged during the first 2 years of life.

The results of the analysis of older children we examined are similar to those of Salardi et al. [2] as regards the

lack of change in uterine volume until the age of 7 years, although in contrast to their study we could not find any significant change in ovarian size until the age of 9 years despite the fact that mean values increase slightly with age. With the onset of puberty uterine and ovarian volume increased progressively in the subjects we studied, with the uterus beginning to increase in size approximately 2 years before the ovaries, at a time when secondary pubertal signs are not yet present. This observation was also made by Salardi et al. [2]. Thus, it can be claimed that an increase in the size of the uterus is one of the very first signs of puberty in girls.

We conclude that reference values for the size of uterus and ovaries are significantly related to age and pubertal stage. These factors must be taken into account, as they are prerequisites for interpreting ultrasound measurements of the pelvic organs correctly.

References

1. Salardi S, Orsini LF, Cacciari E, Partesotti S, Brondelli L, Cicognani A, Frejaville E, Pluchinotta V, Tonioli S, Bovicelli L (1988) Pelvic ultrasonography in girls with precocious puberty, congenital adrenal hyperplasia, obesity, or hirsuitism. J Pediatr 112: 880
2. Salardi S, Orsini LF, Cacciari E, Bovicelli L Tassoni P, Reggiani A (1985) Pelvic ultrasonography in premenarcheal girls: relation to puberty and sex hormone concentrations. Arch Dis Child 60: 120
3. Ivarsson SA, Nilsson KO, Persson PH (1983) Ultrasonography of the pelvic organs in prepubertal and postpubertal girls. Arch Dis Child 58: 352
4. Tassini P, Salardi S, Orsini LF, Bovicelli L, Mazzanti L, Cicognani A, Cacciari E (1984) Ultrasound biometry of pediatric female internal genital structures. Pediatr Res 18: 114
5. Tanner JM, Whitehouse RH (1976) Clinical longitudinal standards for height, weight, height velocity, weight velocity and stages of puberty. Arch Dis Child 51: 170
6. Krantz KE, Atkinson JP (1967) Gross anatomy. Ann NY Acad Sci 142: 551
7. Stanhope R, Adams J, Jacobs HS, Brook CGD (1985) Ovarian ultrasound assessment in normal children, idiopathic precocious puberty, and during low dose pulsatile gonadotrophin releasing hormone treatment of hypogonadotrophic hypogonadism. Arch Dis Child 60: 116
8. Bundscherer F, Deeg KH (1988) Die sonographische Beurteilung der Uterusentwicklung im Kindesalter. Monatsschr Kinderheilkd 136: 246
9. Radfar N, Ansusingha K, Kenny FM (1976) Circulating bound and free estradiol and estrone during normal growth and development and in premature thelarche and isosexual precocity. J Pediatr 89: 719

Literature in pediatric radiology

Continued from p. 10

Medical and Pediatric Oncology *(New York)*

Ectopic neuroblastoma of the thoracic wall: a case report. Cavallaro, S. et al. (Pineschi, A., Dept. of Ped. Surg., Regina Margherita Children's Hosp., Piazza Polonia 94, I-10126 Turin, Italy) 21: 629 (1993)

Anterior pituitary function and computed tomography/magnetic resonance imaging in patients with Langerhans cell histiocytosis and diabetes insipidus. Broadbent, V. et al. (Dept. of Haematol. and Oncol., Hosp. for Sick Children, Great Ormand St., London, WC1N 3JH, England) 21: 649 (1993)

Avascular femoral head necrosis in pediatric cancer patients. Hanif, I. et al. (Pui, C-H., St. Jude Children's Research Hosp., 332 N. Lauderdale, P.O. Box 318, Memphis, TN 38101, USA) 21: 655 (1993)

Hemihypertrophy, bilateral Wilms' tumor, and clear-cell adenocarcinoma of the uterine cervix in a young girl. Stalens, J-P. et al. (Ninane, J., Dept. of Ped. Hematol. and Oncol., Cliniques Univ. Saint-Luc, Av. Hippocrate 10, B-1200 Brussels, Belgium) 21: 671 (1993)

Hypertrophic osteoarthropathy in childhood malignancy. Staalman, C.R., Umans, U. (Dept. of Ped. Rad., AZUA-AMC GI-230, Meibergdreef 9, NL-1105 AZ Amsterdam, The Netherlands) 21: 676 (1993)

Carboplatin-induced regression of an optic pathway tumor in a child with neurofibromatosis. Charrow, J. et al. (Div. of Genetics-59, Children's Memorial Hosp., 2300 Children's Plaza, Chicago, IL 60614, USA) 21: 680 (1993)

Non-midline endodermal sinus tumor in the head and neck region: a case report. Kebudi, R. et al. (Univ., Oncol. Inst., Çapa, Istanbul 34390, Turkey) 21: 685 (1993)

Pediatric Cardiology *(New York)*

Congenital coronary artery fistulae: a review of 18 cases with special emphasis on spontaneous closure. Farooki, Z.Q. et al. (Card. Division, Children's Hosp., 3901 Beaubien Blvd., Detroit, MI 48201, USA) 14: 208 (1993)

Pulmonary blood supply by a branch from the distal ascending aorta in pulmonary atresia with ventricular septal defect: differential diagnosis of fifth aortic arch. Yoo, S-J. et al. (Moes, C.A.F., Dept. of Diagn. Imaging, The Hosp. for Sick Children, 555 Univ. Av., Toronto, Ont., Canada M5G 1X8) 14: 230 (1993)

Scimitar syndrome associated with partial anomalous pulmonary venous connection at the supracardiac, cardiac, and infracardiac levels. Geggel, R.L. (New England Med. Center, 750 Washington St., Box 223, Boston, MA 02111, USA) 14: 234 (1993)

Superoinferior ventricles with criss-cross atrioventricular connections and intact ventricular septum. Alday, L.E., Juaneda, E. (Div. of Card., Hosp. de Niños, Bv. Chacabuco 1016, 5000 Cordoba, Argentina) 14: 238 (1993)

Pediatrics *(Evanston IL)*

Nosocomial legionella pneumonia in the neonate. Holmberg, Jr., R.E. et al. (Div. of Ped. Infectious Diseases, Dept. of Ped., Univ. School of Med., Salt Lake City, UT, USA) 92: 450 (1993)

The futility of the chest radiograph in the febrile infant without respiratory symptoms. Bramson, R.T. et al. (Dept. of Rad., Univ. College of Med., General Hosp., Tampa, FL) 92: 524 (1993)

Radiology *(Easton PA)*

Renal vein thrombosis in children: evidence of early flow recovery with Doppler US. Laplante, S. et al. (Patriquin, H.B., Dept. of Rad., Hôpital Sainte-Justine and Univ., 3175 Cote Sainte-Catherine Rd., Montréal, Québec, Canada H3T1C5) 189: 37 (1993)

Extremity osteosarcoma in childhood: prognostic value of radiologic imaging. Lawrence, J.A. et al. (Babyn, P.S., Dept. of Diagn. Imaging, Hosp. for Sick Children, 555 Univ. Av., Toronto, Ont., Canada M5G 1X8) 189: 43 (1993)

Optimal timing of abdominal CT in children: relationship to injection rate. Kuhns, L.R. (Dept. of Ped. Imaging, Children's Hosp., 3901 Beaubien Blvd., Detroit, MI 48201-2196, USA) 189: 49 (1993)

Prevalence and clinical significance of dilated Virchow-Robin spaces in childhood. Rollins, N.K. et al. (Dept. of Rad., Children's Med. Center and Univ. Med. School, 1935 Motor St., Dallas, TX 75235, USA) 189: 53 (1993)

Periventricular leukomalacia: correlation between MR imaging and autopsy findings during the first 2 months of life. Schouman-Claeys, E. et al. (Dept. of Rad., Hosp., 104 Bd Raymond Poincaré, F-92380 Garches, France) 189: 59 (1993)

Archives of Disease in Childhood *(London)*

Self limiting neonatal primary hyperparathyroidism associated with familial hypocalciuric hypercalcaemia. Wilkinson, H., James, J. (Biochemistry Dept., District Hosp., Wigginton Rd., York YO3 7HE, UK) 69: 319 (1993)

Radiological assessment of the atlantoaxial distance in Down's syndrome. Cremers, M.J.G. et al. (Janus Jongloed Research Centre, Univ., Vondellaan 24, NL-3521 GG Utrecht, The Netherlands) 69: 347 (1993)

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